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ABSTRACT

This paper presents the results of three experiments conducted in connection with development of a node-link based teaching/learning strategy. In experiment 1, subjects were instructed to either define concepts selected from a unit of introductory psychology or to describe the relationships existing between pairs of concepts. The cognitive structures of subjects describing relationships were found to be more similar to those of experts in the field of psychology than were those of subjects that defined single concepts. However, confusion in the meaning of the term "relationship" indicated a need for a more structured approach to relationship description activity. One such approach, the Node Acquisition and Integration Technique (NAIT), was discussed in connection with experiment 2. In the first stage of NAIT, students complete relationship-guided "definition worksheets." Next, these definitions are elaborated through formation of mental images, generation of examples and applications, etc. Finally, "comparison worksheets" lead students through relationship-guided comparisons of pairs of previously completed definition worksheets in search of similarities, differences, and direct relationships between the compared concepts. Students then summarize the relationships thus discovered, an activity equivalent to the relationship description activity of Experiment 1, but built up through a series of well-defined steps. A preliminary assessment of NAIT indicated that it was more effective in enhancing episodic and integrative understanding than a no-treatment control. Experiment 3 discusses NAIT evaluation efforts in an ecologically valid college setting. (Author/MB)

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The Node Acquisition and Integration Technique: A Node-Link Based Teaching/Learning Strategy

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The Node Acquisition and Integration Technique: A Node-Link Based Teaching/Learning Strategy

Several recent models of long-term memory (LTM) structure suggest that information is stored in heirarchically organized networks of verbal and imaginal nodes connected by several types of named links (e.g., Collins & Quillian, 1969, 1972; Crothers, 1970, 1971a, 1971b; Kintsch, 1972, 1974; Lindsay & Norman, 1972; Meyer & Schvansveldt, 1976; Norman, 1973; Quillian, 1968; Rumelhart, Lindsay, & Norman, 1972). As an example of the kinds of semantic networks envisioned by node-link memory models, consider the passage below and one example of a compatible node-link representation in Figure 1.

> The Prickles and Fantasias are two flowers that grow near the Uganda River. Prickles have short stems and red flowers. They can be contrasted with Fantasias which have long stems and orange flowers. Scientists have determined that all short-stemmed flowers in this area have deep roots. Flowers with deep roots are able to hold tight, but the flowers with shallow roots are being washed away.

Insert Figure 1 about here

Node-link memory models are relevant to several cognitive constructs of importance to educators. For example, it may be seen from Figure 1 that the meaning of any given concept (node) is given by the relations (named links) that link that concept to other concepts, both verbal and nonverbal, in the LTM structure (Forehand, 1974; Paivio, 1971). Several levels of meaning can be distinguished in node-link structures (Bloom, 1956; Carroll, 1971; DiVesta, 1972). The first, the verbal-associative or definitional level, may be said to exist when a concept node is linked to relatively local, verbal defining nodes. The second level, episodic, exists when concept nodes are linked to nonverbal, imaginal or episodic nodes in the LTM structure. A third level of meaning, integrative, exists when concept nodes are highly interconnected through direct links and indirect node-link pathways.

Comprehension, or the extraction of meaning, may be defined in node-link models as the process in which a linguistic input is analyzed into its concepts, links connecting those concepts are discovered, and the resulting node-link network is tied into the individual's previously existing cognitive structure.

This node-link view of meaning and comprehension suggests that teaching and learning techniques should assist the student in entering concept nodes into his cognitive structure, in de-

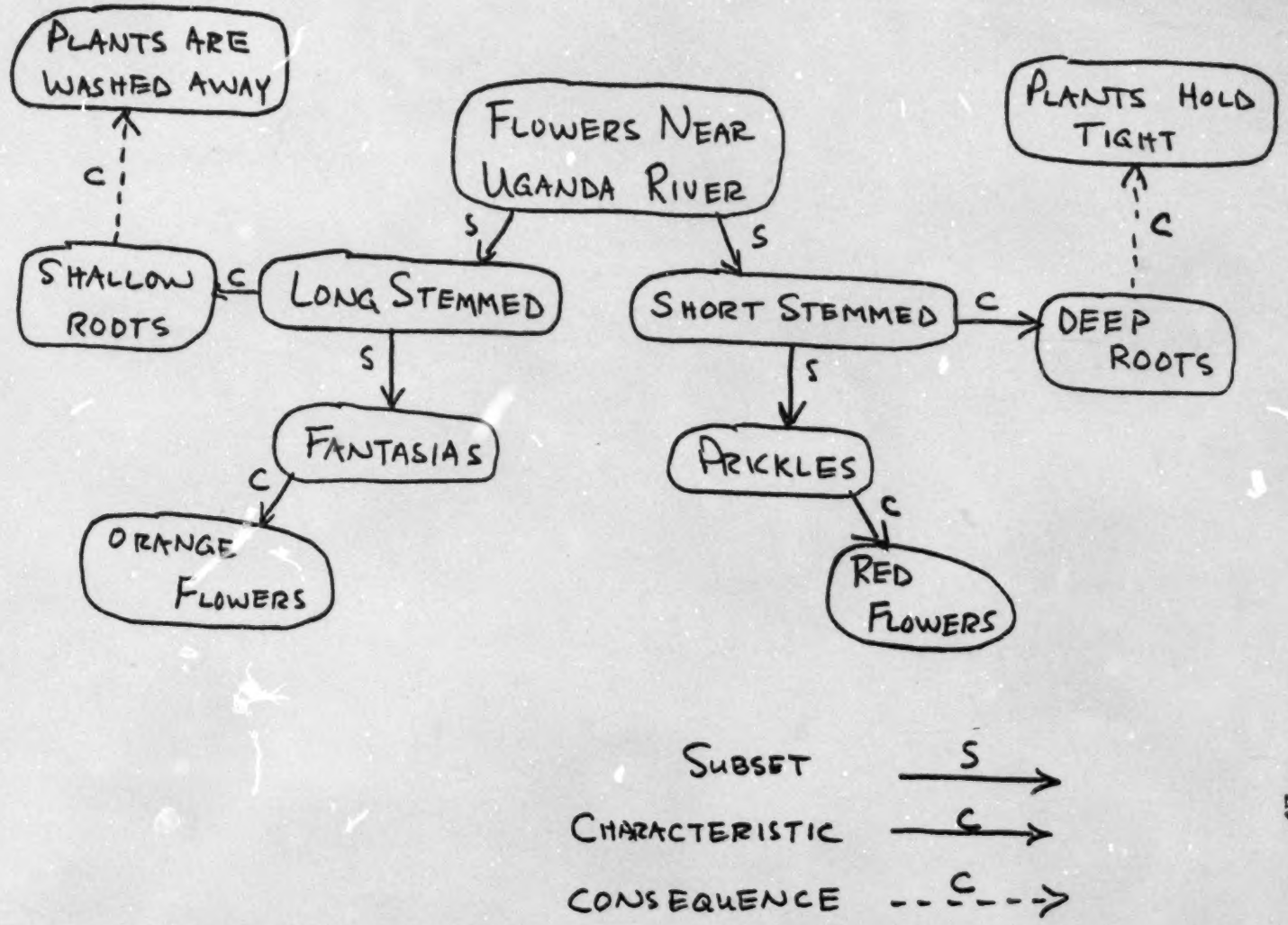

Figure 1

Sample Node-Link Semantic Network

fining these concepts locally using a variety of named links, in tying the concepts into his imaginal/episodic memory structure, and in integrating the concepts by establishing direct links and indirect node-link pathways between them.

The purpose of this paper is to report on the development and preliminary assessment of a node-link based teaching/learning strategy useful in enhancing comprehension and retention of academic materials at several meaning levels.

EXPERIMENT 1

Informal observations as well as a more systematic survey of TCU students (Dansereau, et al., 1975) have indicated that while most students achieve fairly good verbal-associative level understanding, their study methods, primarily definitional in nature, are relatively ineffective in achieving understanding at the episodic or integrative levels. The first experiment was designed to examine the effectiveness of student-generated descriptions of relationships existing between instructor-selected concept pairs in enhancing integrative understanding. Relationship description activity was hypothesized to enhance concept integration by forcing students to establish and examine node-link pathways between concepts which were previously isolated in their cognitive structures.

Method

Subjects

Twenty underachieving students from an introductory psychology class agreed to participate in a brief learning strategy training program. Ten were assigned to the Definition Group and ten were assigned to the Relationship Description Group.

Procedure

Students in the Definition Group were instructed to define eight instructor-selected key concepts from a behavioral measurement unit of introductory psychology. Since students' normal study activity is highly definitional, this group was considered a control group. Students in the Relationship Description Group were instructed to describe the relationships existing between pairs of instructor-selected key concepts. Neither group received special training in the correct application of their assigned study methods.

Following completion of their assigned study, subjects in both groups received a list of all possible pairs of 10 key concepts from the behavioral measurement unit with instructions to rate each pair on a scale of 1-20 to indicate the degree to which

the two concepts of each pair were related. Both groups had been previously exposed to relationship judgment tasks of this sort.

Results

Relationship judgment data from the Definition Group, Relationship Description Group, and a group of five "experts" (third and fourth year psychology graduate students) were analyzed using the INDSCAL multidimensional scaling program (Carroll & Chang, 1970). Two- through four-dimensional solutions were obtained for each group. For each group, the correct dimensionality of the underlying multidimensional space was determined using three criteria: (1) the proportion of variance in relationship judgments explained by the scaling solutions of each dimensionality; (2) the "generality" of the dimensions for each solution (a dimension was assumed to possess some generality if several of the subjects showed a weight of .30 or greater on that dimension); and, (3) the degree to which the dimensions were orthogonal to each other in each solution.

Three-dimensional solutions were accepted as optimal for each group. Dimensions were interpreted for each group by examining the size and signs of the loadings of the ten key concepts on each dimension. It was found that both the Definition Group and the Relationship Description Group made use of Expert Dimensions I and II (interpreted as Manipulation Studies vs. Assessment Studies and Abstract Concepts vs. Concrete Concepts, respectively). Once these corresponding dimensions were determined, it was possible to compare groups' useages of the dimensions, thereby gaining information concerning the degree to which the Definition Group and Relationship Description Group possessed cognitive structures integrated in ways similar to those of experts. Similarity between two groups' use of a corresponding dimension was assessed by rank ordering the ten concepts along that dimension and computing a Spearman rank-order correlation between these two rank orderings. The higher the absolute value of this correlation, the greater the similarity between the groups' useages of the dimension. Correlations between experts' and subjects' useages of Expert Dimensions I and II are presented in Table 1.

Insert Table 1 about here

Subjects in the Relationship Description Group showed substantially greater similarity to experts in their use of corresponding dimensions than was shown by subjects in the Definition Group. Post-experimental examinations of relationship descriptions written by subjects in the Relationship Description Group revealed, however, that several subjects simply defined each concept in the pair and devoted relatively little effort to describing the relationships between the concepts. Post-experimental interviews with these subjects also revealed considerable confusion as

Table 1

Correlations Comparing Subjects' and Experts' Use of Two Expert Dimensions

Groups Compared	Expert Dimension I		Expert Dimension II	
	r	p	r	p
Experts - Definition Group	.455	ns	.345	ns
Experts - Relationship Description Group	.830	.01	.616	.05

to what had been expected of them and as to what was meant by the term "relationship." For this reason, a more structured approach to relationship description as well as more effort spent in training proper use of the technique was deemed desireable.

EXPERIMENT 2

The Node Acquisition and Integration Technique (NAIT) was developed in response to students' apparent need for a structured learning strategy. While NAIT may stand alone in promoting comprehension and retention, it may conceivably be combined with strategies aimed at achieving other goals relevant to the acquisition and utilization of information (e.g., concentration, retrieval, etc.). It should be noted, as a delimiter, that NAIT is designed for use with prose materials which can be easily organized around a set of "key concepts,"

NAIT is a four-stage technique. The first stage, selection of key concepts, is, in the present version of NAIT, accomplished by the instructor, although it may be possible to train students in the selection of key concepts in future versions of NAIT.

The second stage of NAIT, relationship-guided definition of key concepts, is intended to accomplish the goal of achieving relatively local, verbal-associative understanding of instructor-selected key concepts. From the student's viewpoint, definition of key concepts is accomplished through completion of "definition worksheets" like that shown in Figure 2. Each key concept to be

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Insert Figure 2 about here

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defined is entered into the blank provided at the top of a definition worksheet. As the student reads through the material being learned, he fills in each of the first six boxes of each worksheet with information related to the key concept being defined by the link type used as the label for each box. For example, as the student encounters information which can be said to characterize or describe a key concept, it is entered into the box labeled "Characteristics/Description." Similarly, as he encounters information which can be said to refer to the consequences of the key concept, it is entered into the box labeled "Consequences/Influences," and so on for each box of the worksheet.

Relationship-guided definition of key concepts may be seen as beneficial to the learning process in several ways. First, it requires that the learner take an active role in learning. The value of active learning behaviors in enhancing comprehension and retention has been stressed by several investigators (e.g., Bruner,

Figure 2

Sample Definition Worksheet

Key Concept

CHARACTERISTICS/DESCRIPTION
ANTECEDENTS
CONSEQUENCES/INFLUENCES
EVIDENCE
SUBSETS
SUPERSETS
ELABORATION

1965; Rothkopf, 1966, 1970; Rothkopf & Bisbicos, 1967). Second, relationship-guided definition should be of considerable help in insuring comprehension, since comprehension requires precisely the kind of ongoing analysis of verbal material into nodes and link types required by completion of definition worksheets. Third, relationship-guided definition brings about considerable reorganization of information in a passage. Information relevant to the definition of a key concept is frequently scattered throughout a chapter, a result of the linear, sequential nature of language. Completion of definition worksheets, however, draws these isolated bits and pieces together around the concepts which they serve to define. Finally, students are urged to paraphrase definitions given in the passage, thus tying the concepts being defined into the individual's previously existing cognitive structure.

As an example of the use of definition worksheets and the cognitive structures which they are hypothesized to produce, consider the following paragraph and the key concepts ELECTRONS and POSITRONS.

> Electrons are subatomic particles, meaning that they are one of several types of particles which form atoms. Electrons form the outer shell of the atom and orbit around the core or nucleus of the atom. Most electrons have negative electrical charges. But some, called positrons, have positive electrical charges. When an X-ray strikes matter, it may create a pair of oppositely-charged electrons. These electrons destroy each other on contact, releasing large amounts of energy.

Given this passage, a student using NAIT might complete definition worksheets for ELECTRONS and POSITRONS as shown in Figures 3 and 4. The cognitive structure hypothesized to result from completion of these worksheets is shown in Figure 5.

Insert Figures 3, 4, and 5 about here

It can be seen from Figure 5 that although completion of definition worksheets for the concepts ELECTRONS and POSITRONS produced good verbal-associative understanding of each of the concepts, the cognitive structure lacks connectivity to episodic/imaginal information and integration between concepts.

The third stage of NAIT, <u>elaboration</u>, adds verbal, imaginal, and episodic information to the verbal-associative structure established through completion of definition worksheets. In this stage, students (1) form mental images of the key concept; or, (2) think of examples of the key concept, particularly examples from their own experience; or, (3) note information about the key

Figure 3

ELECTRONS
Key Concept

CHARACTERISTICS/DESCRIPTION

have negative electrical charge
form outer shell of atoms
orbit around nucleus of atoms

ANTECEDENTS

CONSEQUENCES/INFLUENCES

destroy positrons on contact, releasing energy

EVIDENCE

SUBSETS

negatively-charged ("electrons")
positively-charged ("positrons")

SUPERSETS

electrons
subatomic particles

ELABORATION

Figure 4

POSITRONS
Key Concept

CHARACTERISTICS/DESCRIPTION

have positive electrical charge
form outer shell of atom
orbit around nucleus of atoms

ANTECEDENTS

may be created when X-rays strike matter

CONSEQUENCES/INFLUENCES

destroy electrons on contact, releasing energy

EVIDENCE

SUBSETS

SUPERSETS
subatomic particles
electrons

ELABORATION

11

Figure 5

Cognitive Structure Following Completion of Definition Worksheets

concept which is of particular personal interest or relevance; or, (4) think of possible applications of the key concept, either realistic or fanciful; or, (5) note questions related to the key concept or phrase; or, (6) express disagreements with the author concerning the key concept's definition.

Considerable evidence supports the positive influence of imagery activity in learning prose materials (e.g., Bull & Wittrock, 1973; Kulhavy & Swenson, 1975; Lesgold, Levin, Shimron, & Guttman, 1974; Lesgold, McCormick, & Golinkoff, 1975; Levin & Divine-Hawkins, 1974; Lewis, 1973). Evidence also supports the use of other, nonimaginal forms of elaboration in enhancing recall of prose material (e.g., Montague, 1972; Paivio, 1971; Ryan, 1975).

Figure 6 illustrates the kinds of changes in cognitive structure hypothesized to occur as a result of elaborative activity. Shown

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Insert Figure 6 about here

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are verbal representations of the concepts ELECTRONS and POSITRONS, nonverbal elaboration of these concepts, and increased connectivity hypothesized to result from elaborative activity. A relative lack of integration remains, however, within the verbal node-link structure.

The fourth and final stage of NAIT, comparison of key concepts, is designed to correct this lack of integration by leading the student to search for similarities and differences in the defining nodes attached to each of the two key concepts as well as direct relationships existing between the concepts. From the point of view of the student using NAIT, comparison of key concepts involves the use of "comparison worksheets" like that shown in Figure 7.

Insert Figure 7 about here

The two key concepts to be compared are entered into the blanks at the top of a worksheet. Then, referring to previously completed definition worksheets for the concepts being compared, the student makes an aspect-by-aspect examination of their definitions in search of similarities, differences, and direct relationships between the concepts. These similarities, differences, and direct relationships are described in the appropriate spaces of the comparison worksheet. For example, information included in the "Antecedents--Similarities & Direct Relationships" box would include a brief listing or description of the antecedents held in common by the two key concepts (similarity). In addition, if one key concept was an antecedent of the other (direct relationship), this fact would be noted If the key concepts were found to have different-but-comparable antecedents (as in the case where the two key concepts resulted from opposite antecedents) this information would be noted in the box labeled "Antecedents--Differences."

13

Figure 6

Cognitive Structure Following Definition and Elaboration

16

17

Figure 7

KEY CONCEPTS

Similarities & Direct Relationships	Differences
CHARACTERISTICS/DESCRIPTION	
ANTECEDENTS	
CONSEQUENCES/INFLUENCES	
EVIDENCE	
SUBSETS	
SUPERSETS	
SUMMARY	

Information concerning similarities, differences, and direct relationships in each of the remaining aspects of the definitions of the concepts being compared would be sought in similar aspect-by-aspect comparisons between the key concepts' definitions. Having once completed a comparison worksheet in this manner, the student "reads through" his worksheet and writes a summary description of the relationships between the two key concepts. This summary is entered into the space labeled "Summary" at the bottom of the worksheet. It should be noted that the summary statement is equivalent to the written relationship description used by the Relationship Description Group of Experiment 1, but is built up from a series of well-defined activities.

A comparison worksheet for the previously defined concepts ELECTRONS and POSITRONS is presented in Figure 8. Figure 9 illustrates the reorganization towards increased concept integration hypothesized to result from completion of the comparison worksheet.

Insert Figures 8 and 9 about here

Experiment 2 was conducted to pilot test NAIT training and assessment procedures prior to a more formal evaluation.

Method

Subjects

Nine students from an introductory psychology course served as subjects in Experiment 2. Of these nine, six completed a 3-hour NAIT training program and three served as a no-treatment control group.

Procedure

The NAIT training program included an introduction, overview, and rationale for NAIT, followed by instructions, examples, and practice in the use of each stage of NAIT. Exercises were of increasing difficulty and length and were accompanied by feedback consisting of sample correct worksheets and written protocols.

Following training in the use of NAIT, all subjects received a 2100-word passage on social psychology. NAIT-trained subjects were instructed to define and elaborate eight specified key concepts and to complete comparison worksheets for five specified pairs of concepts. Control subjects received the same list of concepts and concept pairs, but were told to study the passage in their usual manner, paying particular attention to information related to the listed concepts and concept pairs.

Three days following their study of the assessment passage, all subjects were given an assessment examination. This four-part examination included items designed to tap verbal-associative,

Figure 8

ELECTRONS — POSITRONS — 16

KEY CONCEPTS

Similarities & Direct Relationships	Differences
CHARACTERISTICS/DESCRIPTION	
Both orbit the nucleus. Both form outer shell of atom.	Electrons have negative charge while positrons have positive charge.
ANTECEDENTS	
Electrons + X-rays are antecedents for positrons.	While the antecedents for positrons are specified, no antecedents are given for electrons. Electrons seem to exist "naturally" whereas positrons are an "unnatural" occurence.
CONSEQUENCES/INFLUENCES	
Electrons and positrons destroy each other on contact, releasing energy.	
EVIDENCE	
SUBSETS	
Positrons are a subset of electrons.	
SUPERSETS	
Both are types of electrons. Both are types of subatomic particles.	

SUMMARY

Electrons and positrons are subatomic particles that orbit the nucleus, forming the outer shell of atoms. Electrons are negatively charged while positrons are positively charged. Perhaps this difference in electrical charges causes them to destroy each other on contact, releasing energy. Electrons occur naturally while positrons are created by X-rays.

17

Figure 9

Cognitive Structure Following Completion of Comparison Worksheet

21

22

episodic, and integrative understanding. In addition, subjects were asked to judge the strength of relationships existing between all possible pairs of the eight concepts. Subjects were told that two concepts could be considered related to the extent that one could use one concept in discussing the other.

Results

Due to the small number of subjects involved in Experiment 2, only descriptive statistics will be presented here. Means of performance on items tapping verbal-associative, episodic, and integrative understanding are presented for both groups in Table 2.

Insert Table 2 about here

Inspection of Table 2 shows that little difference existed between NAIT and control subjects at the verbal-associative level of understanding. This result was expected since normal study methods include much definitional activity (albeit less systematic than the relationship-guided definitional activity of NAIT) of the sort expected to produce good verbal-associative level understanding.

Contrary to prediction, episodic level understanding was not found to be enhanced by elaborative activity. NAIT and control subjects showed approximately equal episodic understanding of concepts which were defined and elaborated by NAIT subjects. Post-experimental interviews and examination of NAIT subjects' study materials revealed, however, that elaborative activities were little used by NAIT subjects. Thus, the value of elaborative activities in enhancing comprehension and retention did not receive an adequate test in this pilot study. Concepts which were used in comparisons by NAIT subjects were, however, better understood at the episodic level by NAIT subjects than by controls, an unexpected benefit of comparison activity.

Integrative level understanding was found to be higher among NAIT subjects than controls, both for concepts which were only defined and elaborated as well as for concepts which were used in comparisons. This finding suggests that NAIT subjects may have been able to use the aspect-by-aspect comparison strategy at the time of testing in achieving concept integration as called for by test items. The more complete definitional data base assumed to be achieved through relationship-guided definition may also have assisted NAIT subjects in achieving superior concept integration.

Relationship judgments obtained from controls and NAIT subjects were compared in two ways to judgments obtained from four "experts" (graduate students). First, Pearson product-moment correlations

Table 2

Means on Verbal-Associative, Episodic, and Integrative Portions of the Assessment Examination

Groups		Verbal-Associative		Episodic		Integrative	
		Defined & Elaborated	Used in Comparisons	Defined & Elaborated	Used in Comparisons	Defined & Elaborated	Used in Comparisons
NAIT-trained	$\bar{X}$	.67	.95	.56	.64	.67	.71
Control	$\bar{X}$	.67	.90	.53	.41	.50	.65

were computed between each subject's judgments and mean expert judgments. These correlations are presented for each group in Table 3. NAIT subjects were found to show greater similarity to

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Insert Table 3 about here

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experts than did controls. Interestingly, both groups showed increased similarity to experts on concepts which were included in lists of concept pairs given to subjects at the time of study.

Relationship judgments from each group were also submitted to INDSCAL multidimensional scaling analyses. The resulting solutions were compared as discussed in connection with Experiment 1. Results of these analyses are presented in Table 4. It may be seen

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Insert Table 4 about here

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that NAIT subjects used Expert Dimensions I and II (the two most important expert dimensions in terms of variance accounted for) in ways considerably more like experts than did control subjects. Controls did, however, show greater similarity to experts in their use of the third (least important) expert dimension.

Summary and Conclusions

In summary, Experiment 2 provided preliminary evidence supporting the effectiveness of a structured approach to concept definition and relationship description in promoting both episodic and integrative comprehension and retention. NAIT-trained subjects showed enhanced episodic understanding of concepts used in comparisons as well as generally superior integrative level performance. Finally, NAIT-trained subjects showed cognitive structures (assessed by relationship judgment data) considerably more like those of experts than did control subjects.

Several shortcomings of Experiment 2 call, however, for caution in accepting these conclusions. First, the experiment made use of very few subjects. Second, NAIT-trained subjects generally studied the assessment passage longer than did controls, perhaps contributing to their generally superior performance. This is not considered particularly undesireable, except from a design point of view, since the goal of NAIT is to improve comprehension and retention. If it achieves this goal partially as a consequence of bringing students to study longer, the goal has still been met. It remains to be seen, however, if students using NAIT will study longer in an unmonitored study setting. Third, control subjects in Experiment 2 were self-selected, i.e., they became control subjects by indicating an inability to attend strategy training

Table 3

Pearsonian Correlations to Experts' Relationship Judgments

	Defined & Elaborated (3 pairs)		Used in Comparisons (10 pairs)	
	r	p	r	p
NAIT	.392	ns	.648	.05
Control	.006	ns	.387	ns

Table 4

Correlations Comparing Subjects' and Experts' Use of Three Expert Dimensions

Groups Compared	Expert Dimension I		Expert Dimension II		Expert Dimension III	
	r	p	r	p	r	p
Experts - NAIT	.976	.001	.952	.001	.286	ns
Experts - Control	.714	.05	.286	ns	.714	.05

sessions. Finally, placebo effects that may arise whenever a no-treatment control group is used may have existed in Experiment 2, contributing to between-group differences.

EXPERIMENT 3

Experiment 3, being conducted now, was designed to correct some of the shortcomings of Experiment 2 in assessing NAIT's effectiveness in enhancing comprehension and retention of academic materials.

Method

Subjects

Eighty-six students in an introductory psychology course are serving as subjects in Experiment 3. These students were given several graded term project options, including participation in a NAIT training program and completion of a term paper. Term project grades of students choosing the NAIT option are based on quality of participation in the NAIT training program. This fact has already had a noticeable effect in improving subject motivation, relative to earlier studies. The additional fact that NAIT is used in preparing for course-required examinations has also increased the perceived relevance of the training program and has motivated subjects to perform on assessment examinations.

Procedure

The design of Experiment 3 is diagrammed in Figure 10.

Insert Figure 10 about here

Several individual difference measures thought to be related to an individual's ability to learn to use one or more stages of NAIT were included in a pretreatment test battery. Relationships between these measures and NAIT subjects' scores on quizzes included in each unit of NAIT training as well as quality of worksheets completed in preparing for examinations will be investigated. In addition, two of the individual difference measures, a test anxiety scale and a study attitude inventory, will be administered at the end of the NAIT training program in order to assess training-produced changes on these measures.

Test 1, the first of four course-required examinations, was also administered to all subjects prior to any treatment and will provide a baseline for use in evaluating treatment effects.

Figure 10

Design of Experiment 3

Term Paper Control	NAIT-2	NAIT-1
ID Measures	ID Measures	ID Measures
Test 1	Test 1	Test 1
		Definition Training + Quiz
Normal Study	Normal Study	Definition Study
Test 2	Test 2	Test 2
	Definition Training + Quiz	Elaboration Train. + Quiz
Normal Study	Definition Study	Def. & Elab. Study
Test 3	Test 3	Test 3
	Elaboration Train. + Quiz	Comparison Training + Quiz
Normal Study	Def. & Elab. Study	Def. & Elab. & Comparison Study
Test 4	Test 4	Test 4
	Comparison Training	
ID Measures	ID Measures	ID Measures

Progress to Date →

Two NAIT-trained groups are included in Experiment 3, one (NAIT-2) whose training lags behind that of the other (NAIT-1). Comparisons between NAIT-1 and NAIT-2 at each test will enable assessing the effectiveness of each stage of NAIT singly since NAIT-1 subjects will be ahead of NAIT-2 subjects by one NAIT stage at the time of each test. In addition, both NAIT groups may be compared to the no-treatment Term Paper control group.

Preliminary Results

Experiment 3 has progressed at this time to the point indicated in Figure 10. Thus, preliminary results from NAIT-1 subjects are available relating individual difference measures to ability to use relationship-guided definition. In addition, information is available concerning the effectiveness of relationship-guided definition (by NAIT-1 subjects) in influencing performance on Test 2.

Individual difference measures were obtained from 15 of 29 subjects in NAIT-1. Correlations between these measures and scores on a quiz assessing ability to use definition worksheets and the quality of definition worksheets completed in preparing for Test 2 are presented in Table 5.

Insert Table 5 about here

As can be seen, little relationship was found between the individual difference measures administered and ability to use relationship-guided definition worksheets. Multiple R^2 values between individual difference measures and measures of ability to use relationship-guided definition worksheets were .19 and .40, respectively.

Means of performance on items tapping verbal-associative, episodic, and integrative understanding are presented for Tests 1 and 2 in Table 6. An analysis of variance using change scores

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Insert Table 6 about here

(Test 2 - Test 1) revealed no main effect of Groups or Groups x Levels interaction of the sort that would indicate that relationship-guided definition training received by NAIT-1 subjects enhanced their Test 2 performance relative to that of NAIT-2 or Term Paper control subjects. This result is not discouraging, however, since the definition stage of NAIT is seen as valuable primarily in providing the definitional data base upon which subsequent comparison activity can operate.

Table 5

Correlations Between Individual Difference Measures and Two Measures of Ability to Use Relationship-Guided Definition Worksheets

Individual Difference Measures	Definition Quiz	Study Worksheets
Delta Vocabulary Scale (Diegnan, 1973)	.30	.14
Assimilation/Accomodation Scale (Moore, 1975)	-.16	.11
Remote Associates Test (Mednick, 1959)	-.16	.40
Word Relationship Test (Diekhoff, 1977)	-.15	.10
Concentration Questionnaire (Dansereau et al, 1976)	-.04	.01
Test Anxiety Scale (Sarason, 1972)	-.06	.19
Survey of Study Habits & Attitudes (Brown & Holtzman, 1956)	.00	.12
	R^2 = .19	.40

Table 6

Means on Verbal-Associative, Episodic, and Integrative Portions of Tests 1 and 2

Groups	Test 1			Test 2		
	Verbal-Associative	Episodic	Integrative	Verbal-Associative	Episodic	Integrative
NAIT-1	.70	.61	.31	.68	.53	.74
NAIT-2	.67	.52	.22	.63	.44	.77
Term Paper Control	.68	.46	.28	.57	.42	.80

Relationship judgments between selected pairs of concepts were obtained as parts of both Test 1 and Test 2. Correlations between subjects' and experts' relationship judgments are presented in Table 7. An analysis of variance showed no main effect

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Insert Table 7 about here

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of Groups or Group x Test interaction of the sort that would indicate that relationship-guided definition training received by NAIT-1 subjects was useful in promoting similarity to experts' relationship judgments. Again, however, definitional activity was not expected to have this kind of beneficial effect.

Table 7

Pearsonian Correlations to Experts' Relationship Judgments

Groups Compared	Test 1		Test 2	
	r	p	r	p
Experts - NAIT-1	.64	.01	.12	ns
Experts - NAIT-2	.57	.05	-.03	ns
Experts - Term Paper Control	.50	.10	.01	ns

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